CLAIMS

1. A method of filling a hole or trench in an integrated-circuit assembly with metal, the method comprising:

forming a hole or trench in a layer of the integrated-circuit assembly;

forming a first diffusion barrier inside the hole or trench;

forming a second diffusion barrier on the layer adjacent the hole or trench through jet-vapor deposition of a diffusion-barring material; and

at least partially filling the hole or trench with metal.

2. The method of claim 1 wherein forming the first diffusion barrier occurs before forming the second diffusion barrier.

3. The method of claim 1 wherein forming the hole or trench occurs before forming the second diffusion barrier.

4. The method of claim 1 wherein forming the first diffusion barrier comprises ionized-magnetron sputtering of a first diffusion-barring material.

5. The method of claim 1 wherein the metal comprises copper and forming the first diffusion barrier comprises ionized-magnetron sputtering of a copper-diffusion-barring material.

6. The method of claim 1 wherein the metal comprises copper and forming the second diffusion barrier comprises jet-vapor deposition of a copper-diffusion-barring material.

7. The method of claim 1 wherein forming the second diffusion barrier comprises establishing an acute angle of incidence for the jet-vapor deposition of the diffusion-barring material.

8. The method of claim 7 wherein establishing the acute angle of incidence comprises tilting the layer.

9. The method of claim 1 wherein forming the second diffusion barrier comprises rotating the layer about a normal axis of the layer or rotating a jet-vapor nozzle about the normal axis.

10. The method of claim 1 wherein the first diffusion barrier comprises a high-wetting material and the second diffusion barrier comprises a low-wetting material, wherein relative wetting is based on the metal.

11. The method of claim 1 wherein the metal comprises copper.

12. The method of claim 1 wherein the trench or hole has a width not appreciably greater than one-quarter micron

13. The method of claim 1 wherein the layer consists essentially of an insulative material.

14. The method of claim 1 wherein the trench or hole has a perimeter, and wherein the second diffusion barrier has an edge at least a portion of which is substantially flush with a portion of the perimeter.

15. A method of filling a hole or trench in an integrated-circuit assembly with metal, the method comprising:

forming a hole or trench in a layer of the integrated-circuit assembly;

forming a first diffusion barrier inside the hole or trench through magnetron sputtering of a first diffusion-barring material;

forming a second diffusion barrier outside the hole or trench through jet-vapor deposition of a second diffusion-barring material; and

at least partially filling the hole or trench with metal.

16. The method of claim 15 wherein the hole or trench has a perimeter, and the second diffusion barrier has an edge at least a portion of which is substantially flush with a portion of the perimeter of the hole or trench.

17. The method of claim 15 wherein forming the first diffusion barrier occurs before forming the second diffusion barrier.

18. The method of claim 15 wherein forming the hole or trench occurs before forming the second diffusion barrier.

19. The method of claim 15 wherein the metal comprises copper; the first diffusion barrier comprises a tungsten, a titanium tungsten, or a titanium nitride; and the second diffusion barrier comprises a zinc oxide.

20. The method of claim 15 wherein forming the second diffusion barrier comprises establishing an acute angle of incidence for the jet-vapor deposition of the diffusion-barring material.

21. The method of claim 20 wherein establishing the acute angle of incidence comprises tilting the layer.

22. A method of filling a hole or trench in an integrated-circuit assembly with copper, the method comprising:

forming a hole or trench in an insulative layer of the integrated-circuit assembly, the hole or trench having a perimeter;

forming a first copper-diffusion barrier inside the hole or trench through magnetron sputtering of a high-copper-wetting diffusion-barring material;

forming a second copper-diffusion barrier on the insulative layer through jet-vapor deposition of a low-copper-wetting diffusion-barring material, at an acute deposition angle, the second copper-diffusion barrier having an edge substantially flush with at least a portion of the perimeter of the hole or trench;

at least partially filling the hole or trench with copper; and

annealing the copper-filled hole or trench.

23. The method of claim 22 wherein forming the first copper-diffusion barrier occurs before forming the second copper-diffusion barrier.

24. The method of claim 23 wherein the acute angle of deposition results from tilting the insulative layer.

25. The method of claim 22 further comprising rotating the insulative layer during formation of the second copper-diffusion barrier.

26. The method of claim 22 wherein the trench or hole has a width not appreciably greater than one-quarter micron.

27. A method of making a metal structure for an integrated circuit, the method comprising:

forming a hole or trench in an insulative layer, the hole or trench having a perimeter;

forming a first diffusion barrier inside the hole or trench through magnetron sputtering of a first diffusion-barring material;

forming a second diffusion barrier on the insulative layer through jet-vapor deposition of a second diffusion-barring material at an acute deposition angle, the second diffusion barrier having an edge substantially flush with at least a portion of the perimeter of the hole or trench;

depositing metal on the first and second diffusion barriers; and

annealing the deposited metal and the first and second diffusion barriers.

28. The method of claim 27 wherein forming the first diffusion barrier occurs before forming the second diffusion barrier.

29. The method of claim 27 further comprising rotating the insulative layer during formation of the second diffusion barrier.

30. The method of claim 27 wherein the trench or hole has a width not appreciably greater than one-quarter micron.

31. A method of electrically connecting first and second integrated devices in an integrated circuit, the method comprising:

forming a first layer including first and second conductive vias electrically coupled to the respective first and second integrated devices;

forming an insulative layer on the second layer;

forming a trench in the insulative layer that extends at least from the first conductive via to the second conductive via, the trench having a perimeter;

forming a first diffusion barrier inside through magnetron sputtering of a first diffusion-barring material;

forming a second diffusion barrier on the insulative layer and flush with the perimeter of the trench through jet-vapor deposition of a second diffusion-barring material, at an acute deposition angle;

depositing metal on the first and second diffusion barriers; and

annealing the deposited metal and the first and second diffusion barriers.

32. A method of filling a hole or trench in an insulative layer with metal, the method comprising:

forming a first diffusion barrier inside the hole or trench through magnetron sputtering of a first diffusion-barring material;

forming a second diffusion barrier outside the hole or trench; and

at least partially filling the hole or trench with a metal.

33. The method of claim 32 wherein forming the second diffusion barrier comprises

jet-vapor deposition of a second diffusion-barring material at an acute deposition angle.

34. A method of forming a material layer in contact with an edge of a trench or hole, but not within the trench or hole, the method comprising:

forming a trench or hole in the first layer, the trench or hole having an edge; and

jet-vapor depositing the material layer on the first layer at an acute deposition angle, after forming the trench or hole.

35. The method of claim 34 further comprising moving the first layer during the jet-vapor deposition.

36. The method of claim 35 wherein moving the first layer comprises rotating the first layer.

37. The method of claim 34 wherein the material layer comprises a metal-diffusion-barring material.

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38. An integrated-circuit assembly comprising:

an insulative layer having a trench or hole, the trench or hole having an edge;

a first diffusion barrier inside the trench or hole; and

a second diffusion barrier on the trench and having an edge substantially flush with a least a portion of the edge of the trench or hole, the second diffusion barrier comprising a zinc oxide material.

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